IMPROVEMENTS IN TECHNIQUES AND EQUIPMENT FOR PRODUCTION OF A COMMON GREEN LACEWING, *CHRYSOPA CARNEA*

ARS-S-143

September 1976

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

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IMPROVEMENTS IN TECHNIQUES AND EQUIPMENT FOR PRODUCTION OF A COMMON GREEN LACEWING, *CHRYSOPA CARNEA*

By R. K. Morrison and R. L. Ridgway[1]

ABSTRACT

Improved techniques and equipment for rearing *Chrysopa carnea* Stephens were developed. A modified larval rearing frame and the development of special handling equipment reduced labor requirements for the production of eggs and adults. Production records from January 1971 to December 1972 show that during peak production (June, July, August) in 1971 about 220,000 eggs per day were produced, with an average return of about 12 eggs per female per day per 21-day oviposition period. The rearing frame returned adults from 61 percent of the cells initially set up. Peak production (June, July, August) during 1972 yielded about 300,000 eggs per day, with an average return of 13 eggs per female per day per 21-day oviposition period. The rearing frame returned adults from 72 percent of the cells initially set up. **KEYWORDS: biological control (insects), *Chrysopa carnea*, inundative release of *Chrysopa carnea*, predaceous insects, rearing of predaceous insects, *Sitotroga cerealella*.**

INTRODUCTION

Continued research using inundative releases of *Chrysopa carnea* Stephens[2] against *Heliothis* spp. in cotton has emphasized the need for new or improved methods that allow consistent production of this insect at predictable levels for field release.[3] These methods must allow for rapid buildup prior to peak periods of need so that rearing cost be kept reasonable and material not be wasted.

This report describes improved production methods and results obtained with them from January 1971 to December 1972.

METHODS AND MATERIALS

Stock cultures of about 1,500 *C. carnea* were field-collected from cotton each year during late September and early October, held at maintenance levels over winter, and then rapidly increased to meet predetermined needs.

During both years, new and old cultures were held separately to assure a source if the new culture failed to become established. Also, comparative investigations were made into possible deterioration of cultures held in mass production for extended periods.

All production predictions were made on the assumption that the rearing frame would yield at least a 50 percent return of adults and that during a 21-day oviposition period each female would produce at least 10 eggs per day.

[1] Research entomologists, Cotton Insects Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, P.O. Drawer DG, College Station, Tex. 77840. Ridgway's present address: National Program Staff, Agricultural Research Service, Beltsville, Md. 20705.

[2] Neuroptera: Chrysopidae.

[3] Ridgway, R. L., and Jones, S. L. 1969. Inundative releases of *Chrysopa carnea* for control of *Heliothis* spp. on cotton. J. Econ. Entomol. 62: 177–180.

All rearing during the 2-year period was accomplished at 27°±2° C and 80 percent RH. Constant illumination was provided by cool-white fluorescent lights that gave about 50 footcandles in the rearing areas.

Adult Handling and Egg Collection

The unit used for oviposition and adult feeding consisted of a cardboard, metal-rimmed, 3-gal container 10 in high with a diameter of 9½ in. The bottom was cut out, leaving a ½-in edge, to which a circle of 18-mesh fiberglass screen cut to the diameter of the container was permanently attached. The lid to the container consisted of the regular lid with the center cut out leaving a ½-in edge. A circle of 18-mesh fiberglass screen with a diameter of 12 in was placed on the open top of the container and held in place by the modified lid.

The inside of the container was lined with 40-lb kraft-paper strips 10 by 32 in, lightly glued in place with paper paste.

Prior to placement in the oviposition containers, a strip of adult diet 18 by 1 by ¼ in was placed centrally on the liner and allowed to dry slightly. The diet consisted of one part Food Wheast and one part sucrose (by weight) mixed with sufficient water to form a thick paste (fig. 1).[4] Previously, adults were held in unlined containers with screen bottoms and paper tops. The adult diet was placed directly on the container sides.

Approximately 500 *C. carnea* adults 0 to 24 hours old were placed into freshly prepared oviposition-feeding units (OFU). The adults were held in preoviposition for 4 days with fresh diet being supplied each 24 hours.

Beginning on the fifth day postemergence, the OFU was changed daily with a vacuum device consisting of a 12- by 14- by 8-in box constructed of ⅛-in hardboard. A 7½-in-diameter circle was removed from the center of one of the 12- by 14-in surfaces, and three 1/50-hp, 3-in, squirrel-cage electric fans were positioned on the inside of the box to vent out.

The fans create a sufficient vacuum at the open circle to pull down and hold the adults on the screen bottom of an OFU placed on the device (fig. 2).

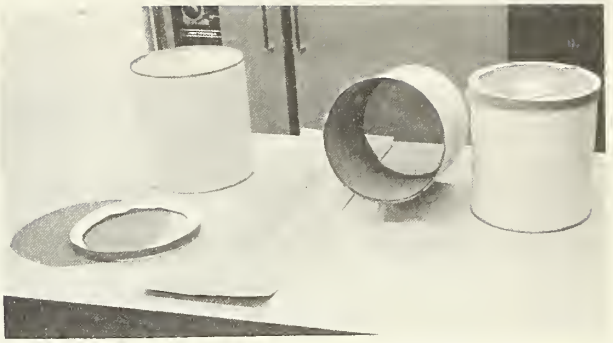

FIGURE 1.—Adult oviposition-feeding unit with screen top, lid, paper liner with diet strip, and cotton watering pad.

Freshly lined OFU's were made up in advance. An OFU to be changed was placed on the vacuum device and rapped gently, causing the adults to be dislodged from the screen top and container sides and held by the vacuum on the bottom screen. The top screen and lid were quickly removed and an empty, freshly prepared OFU inverted over the old. A leather belt 28 by 5 in with handles at each end was placed around the top edges of the two, and both containers, as a unit, turned 180° and placed back on the vacuum device. The old OFU, now on top, was rapped gently again to dislodge the adults, the belt removed along with the old unit, and a fresh screen and lid placed on the bottom unit containing the freshly changed adults. This unit was then removed from the vacuum device and placed on a storage

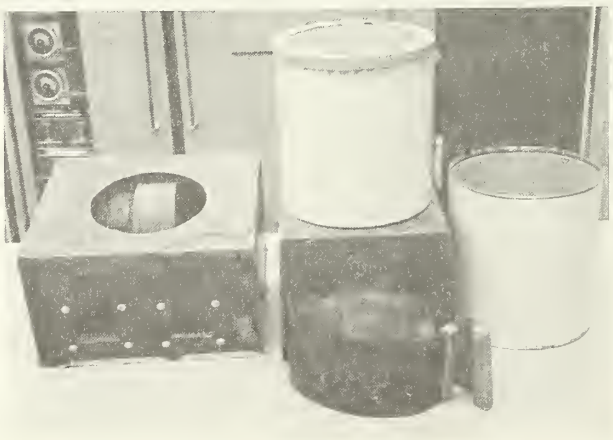

FIGURE 2.—Vacuum device for changing adult oviposition-feeding units, with leather holding belt and spare container.

[4] Hagen, K. S., and Tassen, R. L. 1970. The influence of Food Wheast and related *Saccharomyles fragilis* yeast products on the fecundity of *Chrysopa carnea* (Neuroptera: Chrysopidae). Can. Entomol. 102: 806–811.

rack (fig. 3). Except during the daily change, water-soaked cotton pads were placed on the screen tops to supply free water. After a 21-day oviposition period, the adults were discarded.

After being changed, the kraft-paper liners with the attached eggs were removed from the empty containers and, along with the removed screen tops, held overnight to allow the egg chorion to "cure" or harden. The eggs were then removed. Eggs from the screen lids were removed with a dilute sodium hypochlorite solution as described by Finney.[5] Eggs from the paper liners were removed mechanically as described by Ridgway et al.[6]

[5] Finney, G. L. 1948. Culturing *Chrysopa carnea* and obtaining eggs for field distribution. J. Econ. Entomol. 41: 719–721. Finney, G. L. 1950. Mass-culturing *Chrysopa californica* to obtain eggs for field distribution. J. Econ. Entomol. 43: 97–100.

Adult Production

All adults produced during the 2-year period were reared from eggs on five feedings of frozen eggs of the Angoumois grain moth, *Sitotroga cerealella* (Olivier), at 3-day intervals in 500-cell cloth-masonite rearing frames as described by Morrison, House, and Ridgway (fig. 4).[7]

[6] Ridgway, R. L., Morrison, R. K., and Badgley, M. 1970. Mass-rearing a green lacewing. J. Econ. Entomol. 63: 834–836.

[7] Morrison, R. K., House, V. S., and Ridgway, R. L. 1975. An improved rearing unit for larvae of a common green lacewing. J. Econ. Entomol. 68: 821–822.

FIGURE 3.—Storage rack for adult oviposition-feeding units.

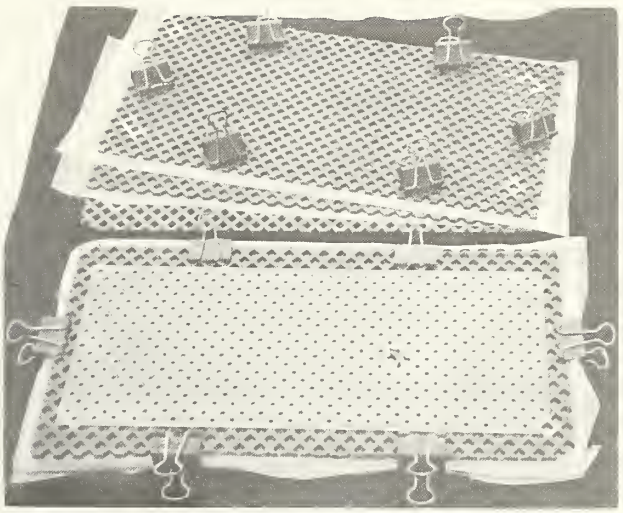

FIGURE 4.—Five-hundred-cell cloth-masonite rearing frame and feeding plate.

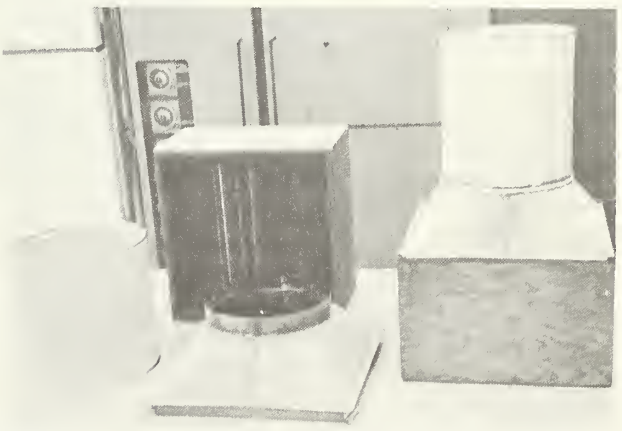

FIGURE 5.—Adult emergence device with box containing frames, metal transition, and collection container.

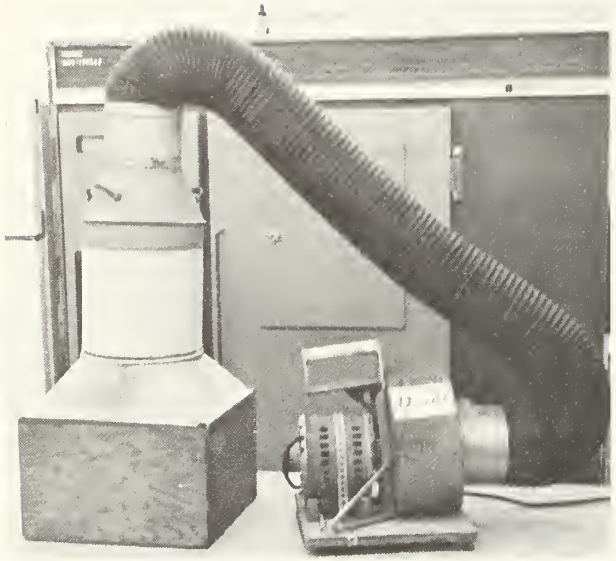

FIGURE 6.—Vacuum device used for daily collection of emerging adults.

Adult Collection and Dispensation

After pupation, the rearing frames were broken down, and any remaining larvae were carefully removed. The frames that contained the pupae were then placed in 15- by 15- by 9-in plywood containers covered with black muslin on the bottom and equipped with racks to hold and separate the frames. A metal transition was placed on top of the container and a spare OFU placed on the transition (fig. 5).

Emerging adults were collected each 24 hours with a vacuum device placed over the OFU. The emergence box was rapped sharply to agitate the emerged adults, which were then drawn into the OFU and held on the screen by the vacuum. The container was then removed from the metal transition on the emergence box and the adults counted while still being held in place by the vacuum. After the count, a screen top and lid placed on the unit before removal temporarily confined the adults. They were easily transferred to other containers by the vacuum system. An empty OFU was replaced on the metal transition and a water-soaked cotton pad was placed on the screen to supply emerging adults with water. Previously, pupae were placed in sleeve cages and collected by aspiration into 1-qt clear-plastic containers.

The vacuum-collection device used in this operation was a modified D-Vac vacuum insect net, the engine of which had been replaced with an electric motor. A metal transition that fitted over the OFU was attached to the end of the 6-ft flexible hose (fig. 6)

TABLE 1.—*Yield of* Chrysopa carnea *pupae and adults reared on* Sitotroga cerealella *eggs in a 500-cell cloth-masonite rearing frame, 1971–1972*

Month	Number of frames		Percentage of cells producing—			
			Pupae		Adults	
	1971	1972	1971	1972	1971	1972
January	(1)	4	(1)	78	(1)	71
February	(1)	15	(1)	89	(1)	81
March	6	15	60	89	53	80
April	9	31	84	85	69	78
May	88	154	86	82	74	70
June	167	245	73	74	60	62
July	210	136	71	81	51	63
August	105	29	79	83	64	73
September	92	23	80	85	61	74
October	92	23	77	82	54	73
November	28	(2)	77	(2)	67	(2)
December	28	(2)	73	(2)	61	(2)
Average	...	...	76	83	61	72

[1] Culture was being increased from field-collected material in 100-cell rearing frames.

[2] Culture was reduced to maintenance level.

TABLE 2.—*Egg production from* Chrysopa carnea *adults reared on* Sitotroga cerealella *eggs in a 500-cell cloth-masonite rearing frame, 1971–1972*

Month	Average daily egg production		Average eggs per female per day	
	1971	1972	1971	1972
January	6,600	5,800	12	12
February	7,300	21,000	14	12
March	5,400	18,800	13	10
April	30,300	28,000	16	10
May	95,600	196,800	14	14
June	222,000	345,800	13	14
July	228,000	337,500	13	14
August	204,400	181,300	12	12
September	123,500	50,900	11	15
October	92,000	37,500	9	14
November	34,600	34,500	7	13
December	26,700	(1)	10	(1)
Average	89,700	114,400	12	13

[1] Culture was discontinued.

RESULTS AND DISCUSSION

The results of 2 years of continuous production are shown in tables 1 and 2. During 1971, an average of 61 percent of the cells initially set up in the rearing frame yielded adults. These adults in turn produced an average of 12 eggs per female per day per 21-day oviposition period.

During 1972, an average of 72 percent of the cells initially set up in the rearing frame yielded adults. These adults in turn produced an average of 13 eggs per female per day per 21-day oviposition period.

Periodic sex-ratio checks of the adults in oviposition consistently showed the sex ratio to approach 1:1, with only slight variations recorded. Weekly samples of 100 randomly selected eggs after removal from the screens and liners showed an average viability of 75±10 percent.

Three technicians were used in conjunction with other rearing programs in operation during the 2-year period, requiring about 16 man-hours per day during peak periods of production.

Periods of relatively stable production required that about 5 percent of the egg production be returned for colony maintenance.

Agricultural Research Service
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in cooperation with
Texas Agricultural Experiment Station
Texas A&M University

*1976 G.P.O. 1750-S/671-583/92

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